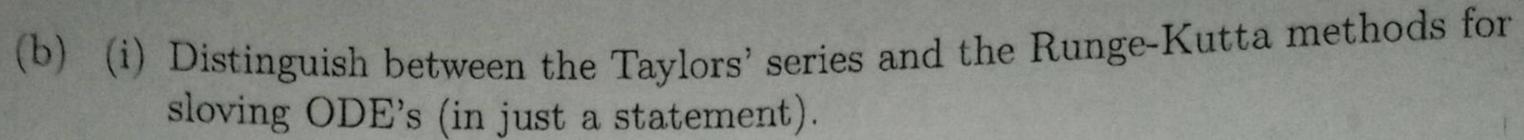


- 1. (a) Outline the types of approximation errors that are common in Mathematical calculations.
 - (b) Suppose y_1 and y_2 are two numbers, Y_1 and Y_2 their respective approximations. If ϵ_1 and ϵ_2 are the resective approximate errors. Determine the
 - (i) error in sum.
 - (ii) error in difference.
 - (iii) error in the product.
 - (c) Determine in which of the intervals [-4, -3], [4, 5], [0, 1], [2, 3] does the cubic equation $x^3 10x + 4 = 0$ has roots.
- 2. (a) Given that Δ is the forward difference operator, ∇ is the backward difference operator and δ is the central difference operator. By first defining each of the operators with respect to a function f_k , show derivation formulas for
 - (i) $\Delta^4 f_k$.
 - (ii) $\nabla^4 f_k$.
 - (iii) $\delta^3 f_k$.
 - (b) (i) From 2(a)(iii) above, approximate the derivative of $f(t) = t^2 + 2t$ at t = -3
 - (ii) Write out suitable iteration formulas for the equation $f(x) = \sin x + x 1$
- 3. (a) By first defining the step up operator E, prove that
 - (i) $\Delta = E 1$
 - (ii) $E^2 = (\Delta + 1)^2$
 - (iii) $\delta = E^{\frac{1}{2}} \nabla = E^{-\frac{1}{2}} \Delta$
 - (iv) $\delta^2 = \nabla \Delta$
 - v) DE = ED
 - (b) Use the Taylor's series to obtain a solution of y' = -xy correct to four decimal places for values $x_0 = 0.0$, $x_1 = 0.1$, $x_2 = 0.2$, $x_3 = 0.3$, $x_4 = 0.4$, $x_5 = 0.5$, with initial conditions y(0) = 1.
- 4. (a) Given the following system of equations:
 - 2a + 3b + c = 9
 - a + 2b + 3c = 6
 - 3a + b + 2c = 8
 - (i) Express the system of equations above in the form AX = B.
 - (ii) Using 4(a)(i) above solve for X.
 - (iii) Determine eigenvalues and eigenvectors for A in 4(a)(i) above (if any)



(ii) Hence state formulas for

(a) Runge-Kutta method of order2

(b) Runge-Kutta method of order3

(c) Runge-Kutta method of order 4.

What necessitates the higher order methods?

$$(A-XT)X=0$$

$$(A-XT)X = 0$$

 $X = A^{1}XX$
 $\lambda =$